

# Growth of Business Capital Equipment 1929-53

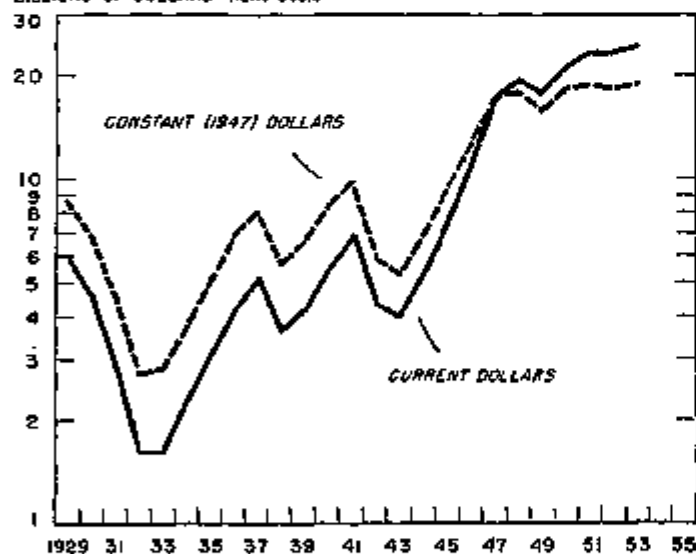
## Measures of Purchases, Depreciation, Retirements, and Stocks

**T**HIS article presents a review of the growth of the stock of privately owned producers' durable equipment for the period 1929-1953, and is based upon an analysis of purchases, retirements, and depreciation of equipment. The study is an extension of the work earlier reported in a more limited statement covering a shorter period, 1941-52, which appeared in the *SURVEY OF CURRENT BUSINESS* for June 1953.

CHART 1

### Private Purchases of Producers' Durable Equipment

BILLIONS OF DOLLARS—Ratio Scale



U. S. DEPARTMENT OF COMMERCE, OFFICE OF BUSINESS ECONOMICS 54-467

A summary of some of the more important findings of the present report follows:

1. The physical stock of privately owned business equipment at the end of 1953 was about twice that of the late twenties. This change has come about as a result of the marked expansion in equipment purchases mainly since 1946. The size of the physical stock of equipment at the end of 1941 was not very different from that at the end of 1928. These figures do not take full account of the improvement in the quality of equipment which has been very pronounced over this period, so that in terms of productive performance the present position is relatively higher.

NOTE.—MR. NASSIMBENE AND MR. WOODEN ARE MEMBERS OF THE NATIONAL INCOME DIVISION, OFFICE OF BUSINESS ECONOMICS.

2. Because of the substantial expansion in purchases of new equipment, the existing stock of equipment is in peak condition.

3. In line with the trend towards increased mechanization characteristic of our economy, the amount of equipment per person engaged in production in 1953 was about 1½ times that of the late twenties.

4. Output per unit of equipment has fluctuated widely over this period, but without apparent long-term trend.

5. Output per person engaged in production in 1953 was about 1½ times that of the late twenties, as a result of increased use of capital, and of improvements in technology, management and organization, and in labor skills.

These conclusions as well as other findings relating to stocks, purchases, and consumption of privately owned producers' durable equipment are discussed in the article.

The results presented are tentative, in part because of the exploratory nature of the work and in part because of data deficiencies and conceptual difficulties that handicap statistical measurement in this field.

### Purchases and Consumption

Attention is first focused on private purchases of equipment and on consumption of equipment as measured by retirements and depreciation. This is followed by a discussion of stocks of privately owned equipment.

#### Private purchase of equipment

Much of the period 1929-53 has been one of sharp fluctuations in private equipment purchases, as can be seen from chart 1. Purchases fell markedly between 1929 and 1932, and rose thereafter to a peak in 1937, at almost the same current dollar level as 1929. Then followed the brief recession of 1938 after which purchases continued to rise, surpassing the 1929 peak for the first time in 1941.

For most of the war period 1942-45, private purchases of equipment were below the 1941 peak largely as a consequence of the shift to Federal Government purchases under the war program. Aside from equipment primarily for the Armed Forces, such as motor vehicles, construction machinery, and communication equipment, Federal purchases included substantial amounts for use in private and publicly owned plants.

The period following 1945 witnessed a marked upsurge in private equipment purchases, which in terms of current dollars rose to successively higher points in the postwar period, interrupted only by the minor dip in 1949.

In the 1929-41 period the course of private equipment purchases in current dollar values was similar to that in physical volume (constant 1947 dollars). Current dollar values fluctuated somewhat more sharply than physical

volumes, but the differences were relatively moderate. Following 1941, however, and particularly during the years 1946-51, equipment purchases reflected not only substantial volume increases but also sharp increases in the price of new equipment.

For example, private purchases of equipment in 1941 were about one and one-sixth times those of 1929 in current dollar values and also in physical volume. By contrast, the current dollar value of private equipment purchases in 1953 was about  $3\frac{1}{2}$  times that of 1941, whereas the physical volume was only about twice as high.

In brief, the period 1929-41 was characterized by relatively constant prices in the cost of equipment and little or no discernible trend in the sharply fluctuating volume of private equipment purchases. In contrast, the 1941-53 period was one of rising prices in the cost of equipment and a large expansion in the volume of private equipment purchases. Much of the analysis will be in terms of these two diverse periods.

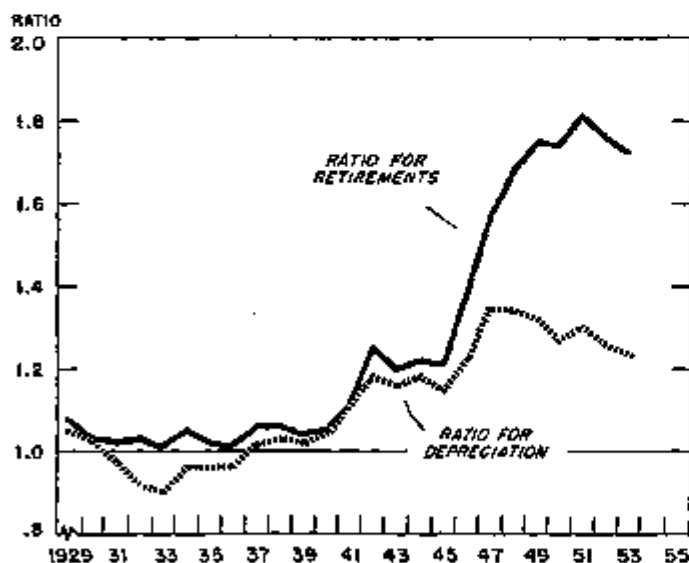
### Measures of capital consumption

There follows a discussion of capital consumption measurement and an analysis of the estimates. An attempt is made to measure the portion of private purchases of new equipment that has been for replacement and the portion that has represented additions to the stock of capital equipment.

CHART 2

### Private Producers' Durable Equipment

Ratio of Current Cost\* to Original Cost  
for Depreciation and for Retirements



\* COST PREVAILING IN EACH YEAR.

U. S. DEPARTMENT OF COMMERCE, OFFICE OF BUSINESS ECONOMICS 52-46-8

The expiration of capital equipment may be measured by two different but related approaches; i. e., by depreciation or by retirements. The usual business practice is to allocate the original cost of depreciable equipment over its useful life. This allocation takes the form of a depreciation charge to expense and is reflected in the net income of the accounting period. The measure of the stock of fixed assets that corresponds to the depreciation approach is a net stock measure, i. e., gross stocks less accumulated depreciation.

Retirements provide an alternative measure. In this approach, a piece of equipment is held at its initial cost until it is retired at which time its cost is completely written off. The stock concept that corresponds to the retirement approach is simply one of gross stocks.

Each of these two approaches has different implications and serves different purposes. Depreciation charges measure capital consumption by providing a rough estimate of the cost of the services rendered by the equipment during the period, and they are relevant for determining current income. The associated net stocks provide a rough measure of the unused store of future services incorporated in existing equipment.

The retirements approach provides a useful basis for making estimates of replacement requirements. Gross stocks of equipment provide a measure that is more closely related than net stocks to productive capacity.

To illustrate this latter point, suppose that a manufacturer has purchased 10 new machines of a given type, each having a useful life of 5 years. These machines will be depreciated every year but retired only at the end of 5 years. At the end of, say, 4 years, the 10 machines would have a depreciated asset value of only one-fifth of their original cost. The capital stock would be measured as the equivalent of 2 new machines by the depreciation approach as contrasted with 10 new machines by the retirements approach. Thus, while in this example the retirements approach somewhat overstates the effective capacity of stocks in the second period as compared with the first, to the extent that the machines are not as good as new, the error would seem to be considerably less than the relative understatement of effective capacity suggested by a measurement based upon the depreciation approach.

Estimating stocks and consumption of producers' durable equipment is difficult. Only scattered data are available relating directly to equipment stocks, equipment retirements, or equipment depreciation. In the absence of adequate direct data, it was necessary in this report to estimate stocks, retirements, and depreciation for the bulk of producers' durable equipment by applying estimates of average useful life to data on purchases of equipment. In calculating depreciation, the straight-line method was used. Retirements and depreciation were calculated in terms of original cost dollars, 1947 dollars, and current dollars. Stocks were calculated in 1947 dollars.<sup>1</sup>

The calculations of capital consumption and stocks are necessarily in the nature of rough approximations. Some of the more important limitations will be touched on briefly at this point since they have an important bearing on the interpretation of the data.

### Conversion of price bases

The usually accepted base for measuring depreciation in accounting practice is original cost. However, other valuation bases are also useful in economic analysis. For example, in measuring the portion of new equipment purchases that is for replacement over a period of years, it is necessary to cost new purchases and retirements on the same valuation base; in this study 1947 dollars are used. Another example relates to the cost of using equipment expressed in current dollars, i. e., at cost prevailing in the specified year. For this purpose it is necessary to convert depreciation in original cost dollars to depreciation in current cost dollars. Adjustment of original cost depreciation to alternative bases of valuation requires the use of price indexes. Of the many

1. An explanation of the procedures used is given at the end of this article. Estimates on retirements were developed in connection with exploratory work undertaken by the Office of Business Economics as part of a study by the Department of Defense. They are an extension of earlier work on this project by Robert N. Gross, then of the U. S. Bureau of the Budget.

problems that arise in connection with price deflation, one is particularly relevant.

Over the long run, price indexes tend to overstate effective price increases and understate price decreases because they do not take full account of improvements in the quality of products. In the instance of producers' durables, quality improvements are, generally speaking, taken into account to the extent that they are reflected in increased costs of producing the equipment; generally speaking, no account is taken of quality improvements which are not reflected in increased costs.

Quality improvements are of particular importance in the case of producers' durables, where technological progress is prominent. Depreciation charges and retirements converted to a current dollar basis would be lower if full allowance could be made for quality changes; and consequently the amounts representing net capital formation in current dollars would be higher, whether measured on the basis of service use or retirements. A similar situation applies with respect to the constant dollar measures. In constant dollars, depreciation and retirements would be lower in relation to total equipment purchases if full allowance could be made for quality improvement, and capital formation net of depreciation or retirements would be higher.

### Straight-line depreciation

Depreciation may be allocated by any of several methods. In this study, the straight-line method was used. Equipment, for example, with a useful life of 5 years was depreciated at the rate of 20 percent a year on its cost for 5 years.

The straight-line method has been the one most frequently used in industry. Other methods are used to some extent. The service-output method employs a depreciation charge which varies with output. The declining-balance method usually employs a fixed rate of depreciation on the net asset value of equipment (i. e., original cost less accumulated depreciation) but other variants are also used.

The declining-balance method may become increasingly important in the future as a result of changes in the Internal Revenue Code of 1954. The earlier code permitted a declining-balance rate of one and one-half times the straight-line rate. The new code permits the use of a declining-balance rate twice as great as the straight-line rate on new property purchased after December 31, 1953, having a useful life of 3 years or more, with the privilege of changing over to the straight-line method at any time. (The changeover provision makes it possible to depreciate the asset during its expected life. Without this provision, assets with little or no salvage value could not be fully depreciated during their expected lives.)

The straight-line method tends to underestimate the use derived from equipment in its early years and overestimate the use obtained in later years, basically because obsolescence and physical deterioration make old equipment less serviceable than new equipment. In addition, as a consequence of this—and also because heavy purchases of machinery tend to occur during periods of high activity—equipment is used more regularly during its early years of life. In a stationary economy these biases would not occur or would be offsetting. But in an expanding economy, the straight-line method understates the rate at which productive services in the stock of capital equipment are being used up.

### Average useful life

Among the most serious limitations of the present estimates is the assumption that had to be made regarding the average useful life of the various types of producers' durable

equipment. The only comprehensive information relating to this subject is the average useful lives suggested by the Internal Revenue Service as a guide for calculating depreciation for tax purposes; the present estimates for equipment other than transportation equipment rely largely on this source.

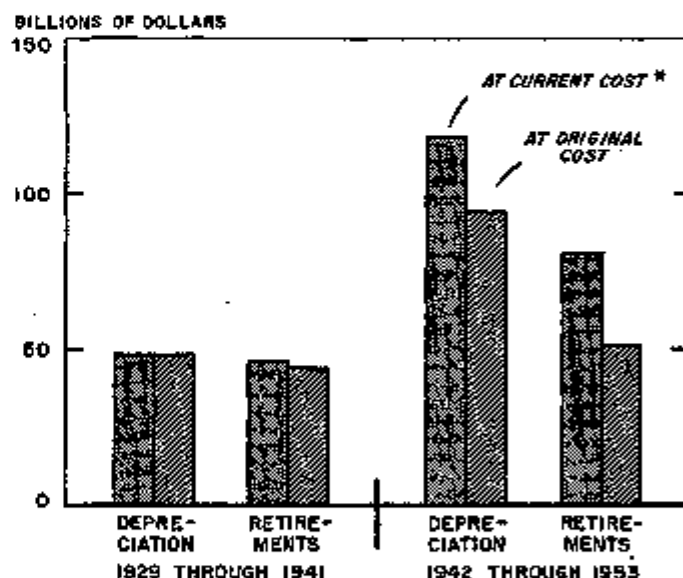
It is difficult to appraise the extent to which actual useful life spans depart from the IRS averages and the direction of the departures; such departures might be either of a constant nature or vary in size with time. A study of several components of the transportation equipment group indicated that the actual life span exceeded the life suggested by IRS. It is felt, however, that because of special factors present in these instances, this bias is not indicative of a similar situation for other types of producers' durables.

For transportation equipment, the IRS average lives were not used. Instead, average lives were used which provided estimates that were generally consistent with available data on stocks and retirements. For railroad equipment, accounting data were used.

CHART 3

### Private Producers' Durable Equipment

Calculated Depreciation and Retirements  
at Current and at Original Cost



\* Cost prevailing in each year of period

U. S. DEPARTMENT OF COMMERCE OFFICE OF BUSINESS ECONOMICS

34-45-3

The limitations imposed by the restricted scope of information on average lives applies with greater force to the estimates of retirements than those for depreciation. Actual retirements for a given year may differ widely from calculated retirements even though the average life expectancies used may be approximately correct. For instance, an important limitation of the estimates of retirements for nontransportation equipment stems from the fact that the estimating procedure could not make allowances for the fact that retirements were postponed during the war period, when it was difficult to replace equipment, into the postwar period when new equipment became available.

While calculations based on average useful lives may not reflect year-to-year changes, the resulting estimates are more reliable statistically if grouped into periods of years. In this study, the data were grouped into two periods thought

to overcome most of the limitations of the use of average life estimates, and which were also most relevant for analysis. The first period, 1929-41, was a more or less static one in net capital formation when considered as a whole, while the second, 1942-53, was a period of marked expansion.

### Consumption—current and original cost

In periods of price advance, depreciation charges based on original cost will not be sufficient to maintain the real value of equipment. In other words, reinvestment of an amount equal to the depreciation charge would not maintain the existing stock of future services. Subject to the previously mentioned limitations, it is possible to estimate roughly the deficiency in any particular year by calculating depreciation in both current year dollars and original cost for the same stock of equipment and then to derive a ratio of current dollar depreciation to original cost depreciation for the year in question.

Table 1.—Private Producers' Durable Equipment: Ratio of Current Cost to Original Cost for Depreciation and Retirements, 1929-53

Year	Depreciation	Retirements	Year	Depreciation	Retirements
1929	1.05	1.08	1942	1.18	1.25
1930	1.02	1.03	1943	1.16	1.20
1931	.97	1.02	1944	1.18	1.22
1932	.92	1.03	1945	1.15	1.21
1933	.90	1.01	1946	1.22	1.38
1934	.96	1.05	1947	1.34	1.57
1935	.96	1.02	1948	1.35	1.38
1936	.96	1.01	1949	1.32	1.76
1937	1.02	1.06	1950	1.27	1.74
1938	1.03	1.06	1951	1.30	1.81
1939	1.02	1.04	1952	1.26	1.76
1940	1.04	1.05	1953	1.23	1.72
1941	1.11	1.11			

Source: U. S. Department of Commerce, Office of Business Economics.

The ratio thus derived provides a rough approximation of the depreciation valuation adjustment which would be required in order to place original cost depreciation on a current replacement cost basis. For example, a ratio of 1.1 means that original cost depreciation would need to be increased by 10 percent to place it on a current replacement-cost basis which would maintain future service use. Conversely, a ratio of 0.9 would require a downward adjustment of 10 percent in order that depreciation cover only the cost of maintaining future service use.

In the instance of retirements, the ratio of current cost to original cost provides a rough comparison between the cost of new equipment and the cost of retired equipment. For example, a ratio of 1.2 means that the new machine costs 20 percent more than the original cost of the retired machine; conversely, a ratio of 0.8 would mean that the new machine costs 20 percent less. Thus, the value of retirements at original cost would need to be modified by these percentages in order to provide for replacement of capacity.

In chart 2, annual ratios of current cost to original cost are shown for depreciation and retirements for the years 1929-53. In interpreting the results the limitations should be kept in mind which stem from the fact that price indexes do not fully reflect quality improvements.

The depreciation ratio of current to original cost fell from about 1.05 in 1929 to 0.90 in 1933, but rose generally thereafter reaching a peak of 1.35 in 1947 as shown in table 1.<sup>2</sup>

2. The depreciation ratios are somewhat higher than would have been obtained by using average lives of Bulletin F of the Internal Revenue Service for transportation equipment.

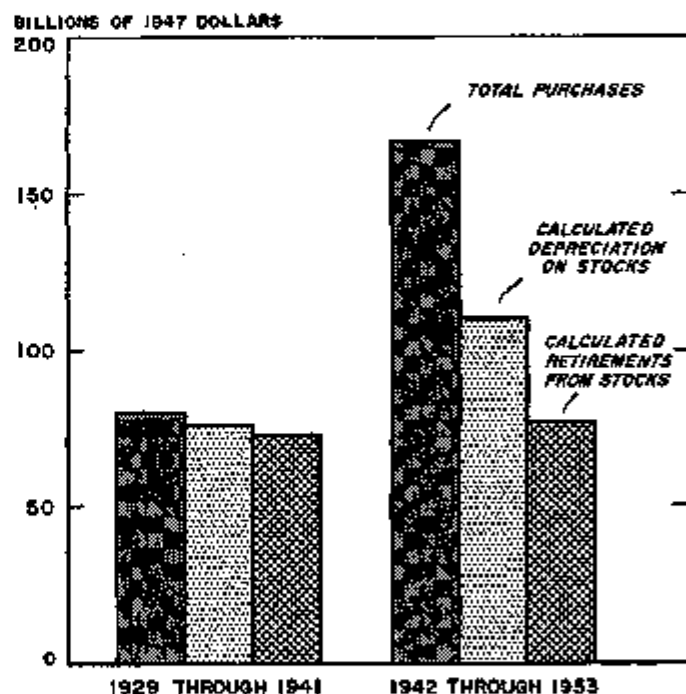
Following 1947 the ratio drifted lower, reaching 1.23 in 1953. It may be of interest to note that in the period 1929-41, ratios above 1.00 were roughly offset by other ratios below 1.00. However, in the period 1942-53, the depreciation ratio was consistently above 1.00 by substantial amounts.

At first glance, the postwar depreciation ratios may appear low in view of the sharp increase in prices during the post-war period. In this connection, two points should be mentioned. First is the fact that the postwar base on which depreciation is computed contains substantial and increasing amounts of equipment purchased at the higher postwar prices. Secondly the ratio also depends upon the lifespan of equipment. The ratio used here is an average which covers all types of equipment. For equipment having shorter than average life, the ratio would be smaller than the average; for longer lived equipment, the ratio would be larger.

CHART 4

### Private Producers' Durable Equipment

Purchases, Depreciation, and Retirements  
in Constant (1947) Dollars



U. S. DEPARTMENT OF COMMERCE, OFFICE OF BUSINESS ECONOMICS 54-46-10

The ratio of current replacement cost to original cost for retirements is generally above that for depreciation, and in recent years by substantial amounts. This relationship necessarily holds in periods of rising prices since the original cost of retirements relate to the time of purchase of retired equipment, whereas the corresponding depreciation ratios relate to the time of purchase of existing equipment. To illustrate: If a given type of machine lasts 15 years, then the retirements for a given year consist only of machines purchased 15 years earlier. But depreciation on the same type of machine is based on existing machines and thus includes all purchases made this year, last year, the year before, and so on for 15 consecutive years. Thus, the average time span between original cost and current cost is much greater for retirements than for depreciation. Consequently, in a period of rising prices, the price differential between original cost and current cost is also much greater.

The ratio of current to original cost for retirements fell from about 1.08 in 1929 to 1.01 in 1933, and then fluctuated between 1.01 and 1.06 until 1941. At the end of the war (1945) the ratio was 1.21. Thereafter a sharp rise got underway and lasted until about 1949. Since then the ratio has been in the neighborhood of 1.75.

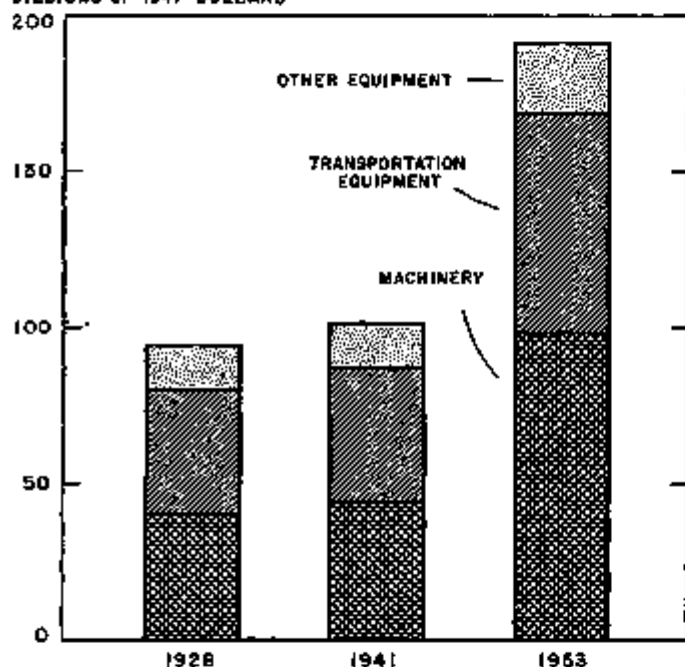
It is of interest to compare estimates of current cost and original cost depreciation and retirements over a period of years. Such a comparison shows the extent to which consumption of capital equipment expressed in original cost dollars falls short of (or exceeds) current-year cost. Chart 3 contains such a comparison for the two periods 1929-41 and 1942-53.

CHART 3

### Private Producers' Durable Equipment

Gross Stocks, End of Year,  
in Constant (1947) Dollars

BILLIONS OF 1947 DOLLARS



U. S. DEPARTMENT OF COMMERCE, OFFICE OF BUSINESS ECONOMICS 54-48-11

For the period 1929-41, total depreciation calculated at current year cost was the same amount as depreciation at original cost for the same stock of equipment. Total retirements at current- and original-year cost were also about the same. Furthermore, depreciation and retirements were of nearly equal magnitude. In explanation it should be noted that in the absence of price trends, original cost and current-cost measures tend to be equal. If, in addition, there is no marked trend in equipment purchases, depreciation and retirements tend to be equal.

The period 1942-53 is in marked contrast with the 1929-41 period. During 1942-53, total depreciation and total retirements at current cost substantially exceeded corresponding estimates at original cost. The divergence is much larger for retirements than for depreciation, for the reasons explained earlier.

Depreciation exceeded retirements during the 1942-53 period by substantial amounts, because of the marked expansion occurring in equipment purchases. In an expanding economy, there is an immediate annual depreciation charge for the increase in the stock of equipment which is not

reflected in retirements until several years later. Consequently in a period of expansion in the stock of capital, annual depreciation charges will exceed annual retirements. In the 1942-53 period the expansion was sufficiently pronounced for depreciation at original cost to exceed retirements at current cost even though there was a sharp rise in the price of new equipment.

The period 1942-53 thus presents an interesting concrete example wherein (1) depreciation at original cost did not cover the current cost of service used up during the period and thus would not, if reinvested, maintain the store of real capital, and yet, (2) the same depreciation at original cost was more than sufficient to cover the current replacement cost of equipment retired during the period. Each of these comparisons has its own significance. The comparison of original-cost and current-cost depreciation focuses on the current cost of using equipment and is therefore particularly relevant to cost, income, and real wealth problems. The comparison of original-cost depreciation and current-cost retirements is particularly relevant to problems of capacity replacement and its financing.

### Purchases, depreciation, and retirements

A comparison of equipment purchases with depreciation and retirements when measured in constant dollars provides a rough indication of the extent to which purchases of capital equipment have been for replacement. Chart 4, plotted in constant 1947 dollars, provides such a comparison for the two periods 1929-41 and 1942-53 which are in sharp contrast.

In the 1929-41 period, private purchases of equipment exceeded depreciation by only a moderate amount and retirements by a somewhat larger amount. The depreciation comparisons suggest that the services used up during the period as measured by depreciation were almost as large as the total volume of equipment purchases during the same period. Consequently, the addition to the store of unused

Table 2.—Private Producers' Durable Equipment: Purchases and Calculated Depreciation and Retirements, 1929-41 and 1942-53

(Billions of dollars)

	1929-41	1942-53
<b>Purchases:</b>		
Current cost.....	51	179
Cost in 1947 dollars.....	80	166
<b>Depreciation:</b>		
Current cost.....	49	116
Original cost.....	48	94
Cost in 1947 dollars.....	76	110
<b>Retirements:</b>		
Current cost.....	46	81
Original cost.....	44	51
Cost in 1947 dollars.....	73	77

Source: U. S. Department of Commerce, Office of Business Economics.

services as measured by net stocks (i. e., gross stocks less accumulated depreciation) was relatively small. Similarly, the retirements comparison suggests that capacity losses from retirements were almost as large as capacity additions from new equipment purchases. Thus, as measured by changes in gross stocks of equipment, it appears that equipment capacity changed but little during the period, apart from the following qualification relating to the influence of technical progress.

The physical volume of gross national product, other than gross product originating in Government, increased



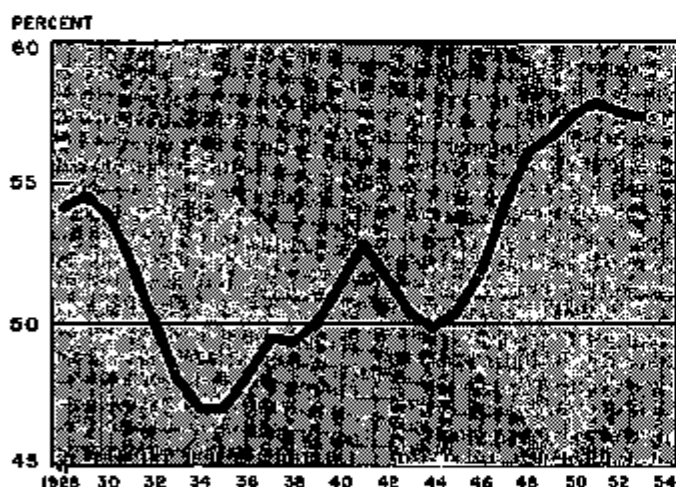
about 28 percent between 1929 and 1941. However, estimated physical gross stocks of equipment increased only 3 percent and total man-hours remained unchanged between 1929 and 1941. While some of the increase in output may have been due to increased labor skills and better organization and management, it is probable that part of it reflected improvements in the quality of equipment of which the measures presented in this report cannot take adequate account.

The period 1942-53 was one of marked expansion, with the volume of private equipment purchases about twice that of the earlier period. Furthermore, substantial portions of equipment purchases were for expansion. In a service-use sense (i. e., depreciation), about one-third of equipment purchases were for expansion and two-thirds were for replacement of used-up services. In a capacity sense (i. e., retirements), more than one-half of equipment purchases were for expansion while the remainder were for the replacement of retired equipment. Thus, whether measured in a service-use sense or in a capacity sense, gross formation of equipment capital exceeded consumption by substantial amounts during the period 1942-53.

CHART 4

### Private Producers' Durable Equipment

Percent of Original Service Use Remaining  
in Gross Stocks, End of Year



U. S. DEPARTMENT OF COMMERCE, OFFICE OF BUSINESS ECONOMICS 54-46-12

Another feature of the chart is of some interest. In spite of a much larger volume of equipment purchases in the period 1942-53 than in the period 1929-41, the volume of retirements was approximately the same. This result is due to the circumstance, noted earlier, that an increase in purchases will result in an increase in retirements only after several years.

A summary of equipment purchases, depreciation, and retirements for the two periods 1929-41 and 1942-53 is shown in table 2.

Attention is now turned to the impact of equipment purchases and consumption on the stocks of equipment in use.

### Stocks of Equipment

By first expressing purchases and calculated retirements in terms of 1947 dollars and then deducting cumulative retire-

ments from cumulative purchases, it was possible to calculate year-end figures of gross stocks of equipment.

### Gross stocks

Gross stocks of equipment at the end of 1928 are estimated in 1947 dollars at approximately \$94 billions. During the next 18 years, comparatively little change took place. It is not likely that stocks of equipment varied from the 1928 level by more than 5 percent until 1941. During the depression following 1929, equipment stocks fell until 1934 or 1935 and increased thereafter, but as can be seen from chart 5, stocks at the end of 1941 were only slightly above those at the end of 1928. Since then, stocks have risen continuously with the greatest expansion taking place after 1945. Equipment stocks at the end of 1953 were almost twice those at the end of 1941.

Machinery and transportation equipment account for the great bulk of equipment stocks. During the thirties, these two broad groups were of about equal importance. In recent years, the share of machinery has increased. More detail on the nature of the changes is shown in table 3.

Relative increases in equipment stocks between 1928 and 1941 were primarily in agricultural machinery and motor vehicles. Nonagricultural machinery stocks rose only slightly, while those of other transportation equipment (consisting primarily of railroad equipment and ships) declined. In the 1941-53 period, all types of equipment stocks increased substantially. Equipment stocks of nonagricultural machinery, agricultural machinery and tractors, and motor vehicles each increased more than 100 percent, while other transportation equipment increased by about a fourth. For the entire span 1928-53, equipment levels of nonagricultural machinery, agricultural machinery and tractors, and motor vehicles each increased by more than 125 percent, while other transportation equipment showed little change.

Transportation equipment other than motor vehicles consists mostly of railroad equipment and ships. Substantial amounts of new railroad equipment were purchased in recent years as a part of the industry's modernization program. This was accompanied by heavy scrapping of old equipment. Productive capacity has undoubtedly expanded more than the statistical measures indicate. As noted earlier, the comparisons cannot take full account of quality improvements. Nor can they take into account the more effective use of rolling stock in the industry.

### Condition of stocks

Gross stocks of equipment were depreciated by using the straight-line method to derive net stocks. (Except for the fact that values are in constant dollars, the resulting net stocks correspond to net asset value in the ordinary sense—i. e., net stocks represent gross asset value less accumulated depreciation.) A measure of the percent of original service use remaining was then obtained by computing the ratio of net stocks of privately owned producers' durable equipment to gross stocks of the same equipment.

In a stationary economy, the ratio of net stocks to gross stocks will be around 50 percent, assuming straight-line depreciation. The ratio, however, is subject not only to cyclical fluctuations but is also influenced by long-term trends. In periods of cyclical decline, it will fall because of a corresponding decline in new equipment purchases. It will also fall during emergency periods if limitations are placed on new equipment purchases. Conversely, it will rise during periods of cyclical advance. In a growing economy, the ratio will tend to keep above 50 percent because stocks of equipment are less than half depreciated.

As can be seen from chart 6, the ratio of net stocks to gross stocks declined from about 54 percent at the end of 1928 to a low of about 47 percent in the midthirties. Thereafter, it rose until the end of 1941 reaching 53 percent at that time. But with the onset of the war and the decline in private purchases of equipment because of wartime restrictions, the ratio again declined to about 50 percent. After 1945 it recovered quickly and by the end of 1948 had reached about 56 percent, from which point there has been little change (as of the end of 1953). From the foregoing comparisons it is apparent that the percent of original service use remaining in the existing stock of business equipment has been of record size in recent years.<sup>3</sup> These percentages also suggest an improvement in the general physical condition of existing equipment.

In summary, gross stocks of equipment at the end of 1953 were almost twice as high as a dozen years earlier, even without taking full account of improved quality due to technological advance. Unused future services stored in existing equipment have increased even more. Finally, the physical condition of equipment stocks may be presumed to be extraordinarily good.

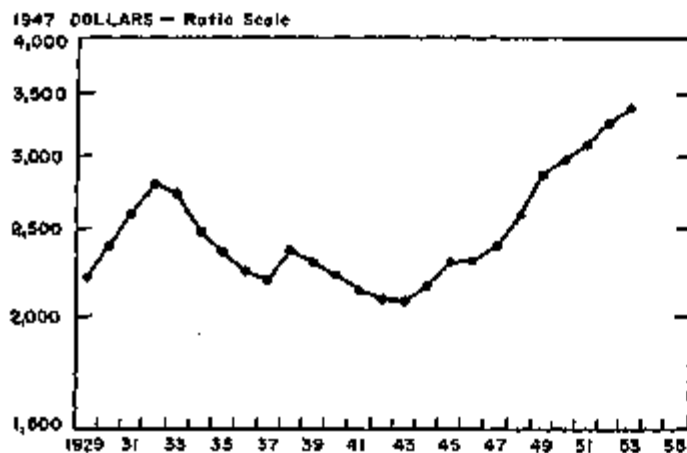
### Equipment Stocks, Labor, and Output

Stocks of producers' durable equipment (as measured in constant 1947 dollars) per person engaged in production, excluding general Government employees but including the self-employed, are shown in chart 7 for the years 1929 to 1953.<sup>4</sup> As can be seen from this chart, equipment per person in 1953 was about 50 percent higher than in 1929. This

CHART 7

### Private Producers' Durable Equipment

Gross Stocks per Worker\*  
in Constant (1947) Dollars



\* Persons engaged in production exclusive of general Government

U. S. DEPARTMENT OF COMMERCE, OFFICE OF BUSINESS ECONOMICS 54-45-13

striking increase was not a unique feature of the 25 years here under review but represented the continuation of tendencies that have characterized also earlier phases of our economic development. Technological trends were undoubtedly the major factors at work, although others, such

as shifts in demand, and changes in the relative costs of equipment, plant, and labor, may have contributed to the result.

Table 3.—Private Producers' Durable Equipment: Percent Change in Gross Stocks for Selected Periods

	Percent change at year-end—		
	1928 to 1951	1941 to 1953	1928 to 1953
Total.....	7	89	103
Machinery.....	11	126	144
Nonagricultural machinery.....	8	118	136
Agricultural machinery and tractors.....	28	135	201
Transportation equipment.....	7	65	76
Motor vehicles.....	38	103	181
Other transportation equipment.....	-14	25	8
Other equipment.....	-1	66	64

Source: U. S. Department of Commerce, Office of Business Economics.

As the result of this increased use of equipment per worker, and also other changes, such as industry shifts, quality improvements, increased labor skills, and better organization and management, output per worker has increased substantially over the period, in spite of the reduction in average working hours that has taken place. As shown in chart 8, output per worker in 1953 was more than 50 percent higher than in 1929. Reflecting, in addition, the reduction in average hours worked, output per man-hours increased by more than two-thirds, or at an annual rate somewhat in excess of 2 percent.

In striking contrast, output per dollar of equipment stock, although it has fluctuated widely, has shown no apparent trend during the period. It ranged from \$1 during the severe depression of the thirties to \$2 during World War II, but the 1953 figure of \$1.50 was approximately the same as the figure for 1929 and was approximated also in other prosperous peacetime years. Moreover, information available for the twenties indicates similar figures for prosperous years of that period also.

There is evidence that the ratio of output to plant followed a movement parallel to the ratio of output to equipment from the early twenties to 1945. Since then, however, the output-plant ratio has risen relatively. In other words, for more than two decades prior to 1945, machinery and plant were used in approximately constant proportions, but since 1945 there has been an increasing use of machinery relative to plant. The causes of this shift are not fully understood, but the fact that construction costs have increased more rapidly than prices of new machinery in the past decade has probably been an important factor. Technological change, industry shifts, and time lags in adjustment may also be involved.

No explanation has as yet been found for the apparent constancy in the output-equipment ratio over long periods. It should be regarded as a tentative finding calling for further empirical verification and economic analysis rather than as a norm that can be projected into the future.

### Note on Methods

Depreciation and retirements were calculated for the years 1929 through 1953, and gross and net stocks for the end of the year from 1928 through 1953 for each of approximately 50 product groups covering the field of producers' durable equipment. Retirements and depreciation were calculated

3. The absolute percentages would be lower if a declining-balance method of depreciation of the type permitted by the Internal Revenue Code of 1954 were used instead of the straight-line method. The trend of the percentages over time using such a declining-balance method, however, would show a pattern broadly similar to that shown here.

4. The values shown here cover only equipment and are in 1947 dollars. Total real capital investment per person engaged in production is of course much higher since it includes not only equipment but also land, plant, and inventories.

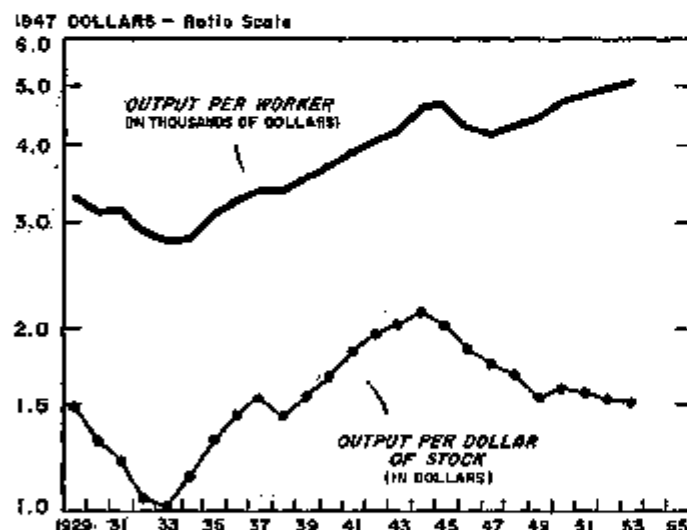
in terms of original cost dollars, 1947 dollars, and current dollars. Stocks were calculated in 1947 dollars. The estimates for all groups except railroad equipment were based on an actuarial-type method, in which estimates of useful life were applied to data on purchases to derive depreciation, retirements, and stocks of equipment. The estimates for railroad equipment were based upon accounting records.

### Groups other than transportation equipment

Estimated useful lives for several thousand pieces of equipment have been published by the Internal Revenue Service in Bulletin "F". The useful lives as reported in the bulletin were matched with detailed production statistics of the value of producers' durable equipment published in the Census of Manufactures. Maximum use was made of the detail afforded by both the value data and the useful life data in assigning useful lives to the individual types of equipment. Where Bulletin "F" did not furnish suitable detail, experts of the then National Production Authority and other Government agencies and private experts were consulted, but Bulletin "F" furnished by far the largest amount of the useful life information utilized.

CHART II

### Output per Worker and per Dollar of Equipment Stock, in Constant (1947) Dollars\*



\* Gross national product exclusive of general Government per person engaged in production and per dollar of private producers' durable equipment stock.

U. S. DEPARTMENT OF COMMERCE, OFFICE OF BUSINESS ECONOMICS 34-49-14

When the individual items of equipment had been assigned useful lives, the items were classified into groups. Generally speaking, the product grouping was in accordance with the three-digit Standard Industrial Classification. The number of items in each group varied considerably, ranging from 1 or 2 to more than 100. For each group, a percentage distribution was prepared reflecting the total value of production classified by length of useful life.

The useful life assigned to each item of equipment was usually not changed from one year to another, but because of the changing importance of individual types of equipment within the groups in different years, the percentage distribution of useful lives for any group could change over time. For this reason, a useful-life distribution was prepared for

each of 5 or more selected years between 1929 and 1953 for each group to test the stability of the distributions over time, and to permit the use of more than one distribution if it appeared that the distribution of any group changed significantly during the period.

The basic purchase data used were the estimates of business purchases of producers' durable equipment from 1929 to 1953 (including capital outlays charged to current expense) prepared in this Office as part of the national income and product accounts. These estimates were modified to include purchases by business from the Government of war-surplus ships, which had been counted as Government purchases when produced. Equipment purchases in the years before 1929 were estimated by extrapolating the OBE series by means of estimates published in Simon S. Kuznets: *Commodity Flow and Capital Formation*, National Bureau of Economic Research, New York, 1938; and in William H. Shaw: *Value of Commodity Output Since 1869*, National Bureau of Economic Research, New York, 1947.

The following procedure was used to obtain depreciation and retirements at original cost. For each group annual purchase values were divided into portions having different useful-life expectancies by the application of the appropriate percentage distribution of useful lives, and each portion was depreciated on the straight-line basis. Thus, depreciation on equipment with a useful life of 5 years was obtained by allocating one-fifth of its purchase cost to each of 5 consecutive years. The estimates of retirements were calculated by counting the entire purchase cost of a given portion as a retirement at the end of its estimated useful life. Thus, the retirements on equipment with an estimated useful life of 5 years were obtained by counting the entire purchase cost as a retirement 5 years after date of purchase. Equipment subject to emergency amortization during the 1941-45 and 1950-53 periods was treated the same as other equipment, the normal useful-life distributions being applied to it.

The estimates of retirements and depreciation were deflated to constant (1947) dollars by first applying price indexes to the original purchase cost of equipment and then repeating the procedure described for the original cost computations. The price indexes used were those that have been constructed for deflating the producers' durable equipment component of gross national product. Constant cost estimates were converted to current costs for a specific year by multiplying the constant dollar cost by the price index for that year.

Gross stocks of equipment in constant dollars as of the end of 1928 were calculated by totaling all equipment purchases made prior to 1929, but not retired as of the beginning of that year. Stocks for successive years were derived by using the 1928 estimate and adding thereto annual purchases and subtracting annual retirements. A similar computation using the purchase estimates and the calculated depreciation was used to estimate net stocks of equipment (gross stocks less accumulated depreciation) for the same period for each group.

### The transportation equipment groups

For railroad equipment, a complete set of estimates of depreciation, retirements, and gross and net stocks was made largely from the accounts of railroads reporting to the Interstate Commerce Commission. The Interstate Commerce Commission data, covering "steam" railroads, private freight-car owners, the Pullman Co., the Railway Express Agency, and interstate electric railroads, were supplemented by data of the American Transit Association on the local transit rail and trolley bus systems. These data yielded estimates at original cost which were converted to other price bases by ICC cost indexes, ICC quantity data on stocks of



locomotives by year of construction available since 1932, and quantity data on stocks of cars by age available for selected years since 1933 from the American Railway Car Institute.

For other types of transportation equipment partial data were available pertaining to some of the required components, such as gross stocks and retirements, but failing to cover others, such as net stocks and depreciation. For these groups, the general method was to make initial estimates of the components for which data were available, and then to devise actuarial-type estimates which would approximate as closely as possible the initial estimates, by experimenting with various useful-life distributions until the desired result was obtained. The complete sets of actuarial-type estimates were used in this report. In this way, the logical interrelation among purchases, retirements, depreciation, and gross and net stocks was ensured; at the same time, the information provided by the actual data was utilized. Conformance between the actuarial-type estimates and the initial estimates based on independent data was high, the general level and the pattern of movement being preserved. In addition, the useful-life distributions used in the actuarial-type estimates were reasonable.

This was the general method of estimation for the transportation equipment groups other than railroad equipment; the specific sources used in making the initial estimates for each such group are described below.

1. Trucks, buses, and trailers: Initial estimates of gross stocks and retirements were prepared from data on total registrations of trucks and buses, on the number of motor-trucks in use by age for selected years beginning in 1941, and on the number of trucks and buses scrapped annually. These data are published by the Automobile Manufacturers Association.

2. Passenger cars: The estimates of business purchases of passenger cars consist of two components: new car purchases and used car dealers' margins. Initial estimates of gross stocks and retirements of the "new car" value portion were made by the same procedure used for trucks, buses, and trailers (see above). In this case the AMA data on the number of passenger cars in use by age were available for selected years beginning in 1935. Actuarial-type estimates were made for used car dealers' margins.

3. Aircraft: An initial estimate of gross stocks at the end of 1951 was made from data of the Civil Aeronautics Administration on the number of civil aircraft registered at that time by year of manufacture.

4. Ships and boats: Initial estimates of gross stocks were constructed. They were based on the OBE producers' durable equipment series on ships, Customs Bureau data on gross tonnage registered annually since 1937 by year of construction, and Maritime Administration data on tonnage and value of Government surplus ships sold to private owners.

It should not be concluded that the estimates for transportation equipment, being based at least in part on independent data on gross stocks and retirements, are more reliable than those for other groups which are based on the more theoretical actuarial-type method which does not have the benefit of these empirical checks. Transportation equipment moves back and forth readily from domestic business use to other uses—by persons, by government, and by foreign nations. This movement presents large problems of estimation; consequently, with the exception of railroad equipment, which should be one of the better estimates, the transportation equipment estimates are believed to be less reliable than the others. (If the actuarial-type method had been used exclusively, without recourse to independent data, these estimates would have been even less satisfactory.)

The present study differs somewhat in methodology from the earlier one appearing in the June 1953 SURVEY.

1. For transportation equipment other than railroads, the present study employs average lives which result in estimates that are consistent with available data on stocks and retirements. The earlier study employed average lives from Bulletin "F" of the Internal Revenue Service.

2. The present study includes capital outlays charged to current expense in capital equipment and depreciates and retires them according to the methods applied to all other equipment. The former study excluded them.

3. For purposes of estimating depreciation and retirements, the present study makes no distinction between equipment subject to emergency amortization and other equipment. The average life expectancy used was the normal useful life. In the earlier study, equipment subject to emergency amortization was depreciated over a period not exceeding 5 years.

## United States Foreign Business Dips During Third Quarter

(Continued from page 12)

the third quarter (as carried in the United States balance of payments) would have been about \$555 million, or about \$120 million less than during the third quarter of 1953.

Third-quarter accumulations by Europe were increased by the seasonal high of United States tourist expenditures and the seasonal low of the European import surplus from the United States, which together account for about \$150 to \$200 million. After rough adjustment for these seasonal factors in transactions with the United States, gold and dollar accumulations were larger than grants to the area at the third-quarter rate, but did not exceed the total of grants plus United States expenditures abroad for offshore purchases under the military-aid program.

Transactions with the sterling area during the third quar-

ter (including the short-term capital outflow of about \$40 million) resulted in net payments by the United States of \$140 million, all of which was derived from United States transactions with the United Kingdom. The remainder of the sterling area did not have an excess of dollar receipts over payments. During the third quarter of 1953, in comparison, the net receipts by the United Kingdom from transactions with the United States amounted to about \$220 million, and of the rest of the sterling area to about \$60 million. It appears, therefore, that a large part of the excess of sterling area receipts from the United States over expenditures here which existed a year ago, has been erased, partly by a reduction in United States grants, and partly by an expansion of sterling area purchases here.